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(54) **RECONSTRUCTION OF TIRE PRESSURE MONITORING SIGNALS**

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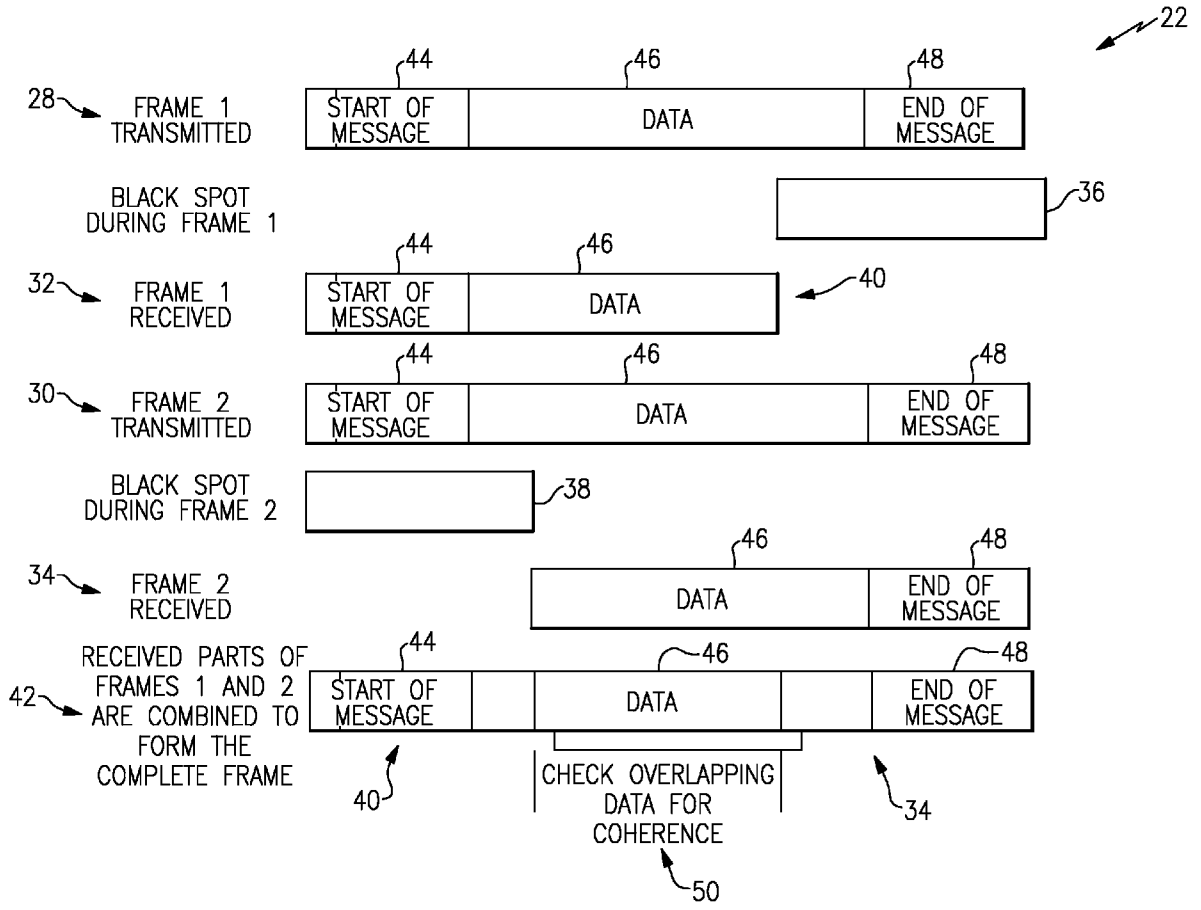
(57) **ABSTRACT**

A tire pressure monitoring system includes a process of reconstructing a complete data frame from portions of partially received data frames. The tire pressure monitoring system includes a receiver that includes a buffer to store portions of the transmissions for reconstruction of data in response to portions of the transmission not being received. A reconstructed data frame is generated using the saved partially received data frame and the currently received partial data frame.



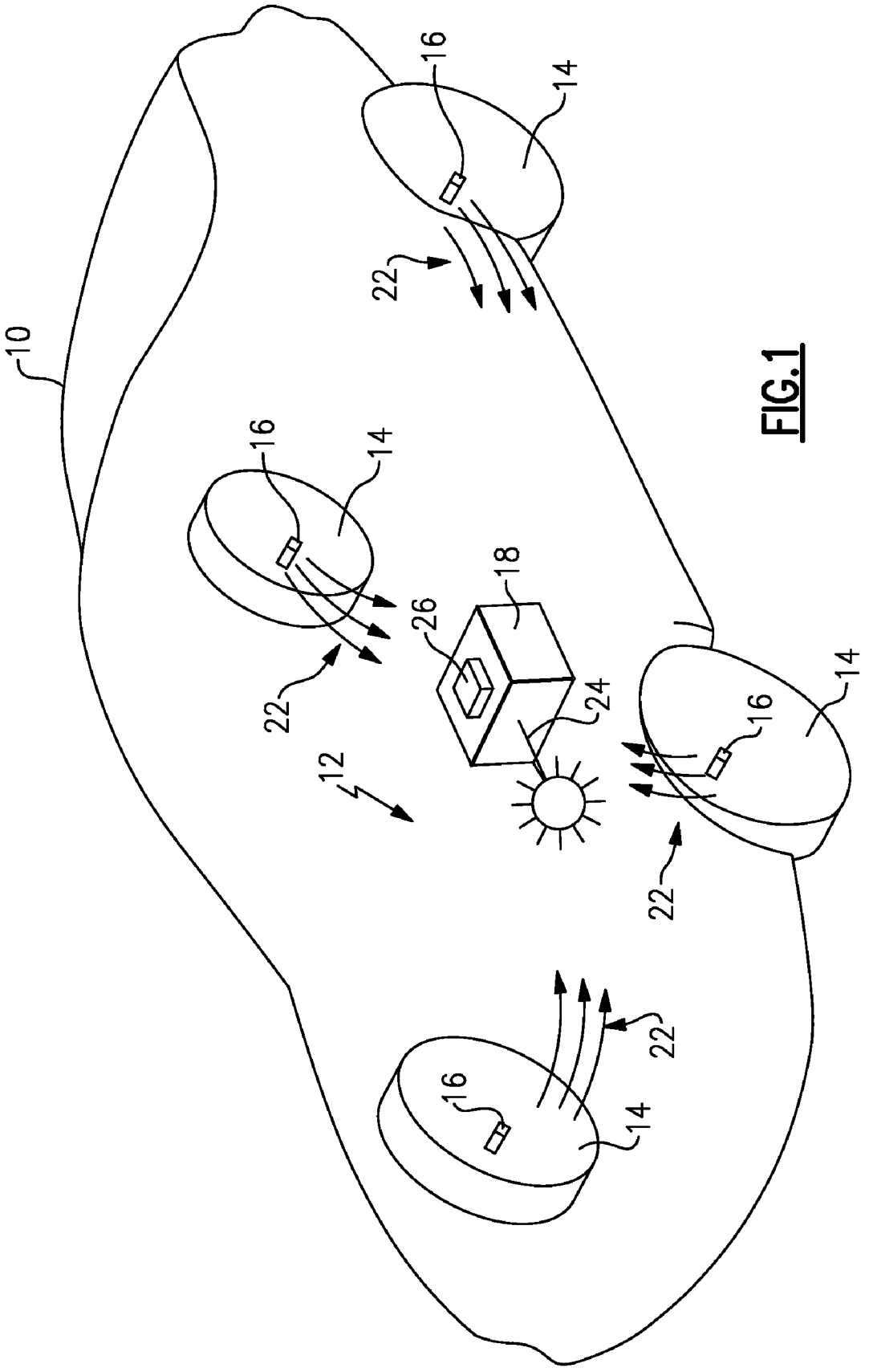


FIG.1

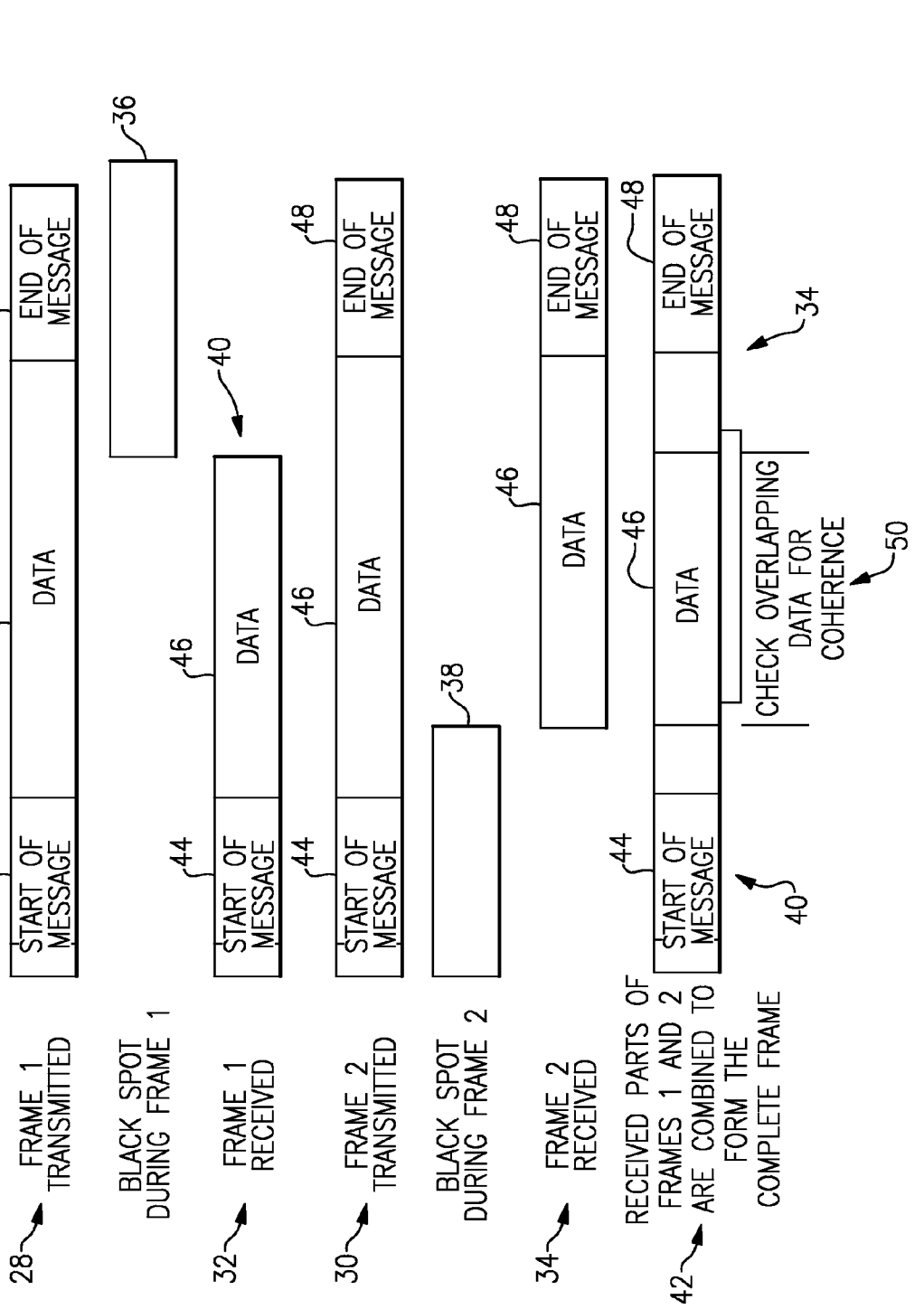

22
36
48
END OF MESSAGE
46
DATA
44
START OF MESSAGE
40
FRAME 1 TRANSMITTED
BLACK SPOT DURING FRAME 1
FRAME 1 RECEIVED
FRAME 2 TRANSMITTED
BLACK SPOT DURING FRAME 2
FRAME 2 RECEIVED
RECEIVED PARTS OF FRAMES 1 AND 2 ARE COMBINED TO FORM THE COMPLETE FRAME
CHECK OVERLAPPING DATA FOR COHERENCE
28
32
30
38
34
42
50

FIG.2

RECONSTRUCTION OF TIRE PRESSURE MONITORING SIGNALS

CROSS REFERENCE TO RELATED APPLICATION

[0001] The application claims priority to U.S. Provisional Application No. 60/906,697 all filed on Feb. 23, 2007.

BACKGROUND OF THE INVENTION

[0002] This invention generally relates to method increasing signal robustness. More particularly, this invention relates to a method of reconstructing partially received data from a tire monitoring sensors with a receiver within a motor vehicle.

[0003] A system for transmitting signals from remote transmissions such as for example a tire pressure monitoring system for a motor vehicle transmits several identical repeated data frames for each pressure data point. The location and relative movement of the transmitter relative to the receiver can result in partially blocked portions of the transmission. The partially blocked portions can result in only a partial portion of any one data frame being received. The partial data frames are not useful and the receiver disregards the data contained therein.

[0004] Disadvantageously, the blocked out portion of a transmission can be such that it repeatedly blocks a portion of each data frame, resulting in the complete loss of data contained in a transmission. A repeated and cyclical failure to receive transmitted data may prevent communication of data that is required to make informed operating decisions.

[0005] Accordingly, it is desirable to design and develop a system and process for recovering data from partially blocked transmissions.

SUMMARY OF THE INVENTION

[0006] An example a tire pressure monitoring system includes a process of reconstructing a complete data frame from portions of partially received data frames.

[0007] The example disclosed tire pressure monitoring system includes a receiver that processes transmissions from each of a plurality of tire pressure monitoring sensor transmitters. The receiver includes a buffer to store portions of the transmissions for reconstruction of data in response to portions of the transmission not being received. A reconstructed data frame is generated using the saved partially received data frame and the currently received partial data frame. Because the transmitted data frames are identical, the data can be reconstructed by checking for overlapping identical data. The overlapping identical data is utilized to align the saved partial frame with the received partial frame to create the combined and reconstructed data frame that is processed and utilized by the receiver.

[0008] Accordingly, the disclosed method and system provide for the recovery of partially received messages to decrease the possibility that data contained in any transmission is completely lost.

[0009] These and other features of the present invention can be best understood from the following specification and drawings, the following of which is a brief description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a schematic view of a vehicle including a tire pressure monitoring system.

[0011] FIG. **2** is schematic view of sequence of transmission and reconstruction of several data frames.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0012] Referring to FIG. **1**, a vehicle **10** includes a tire pressure monitoring system **12**. The tire pressure monitoring system **12** includes a receiver **18** that processes transmissions **22** from each of a plurality of tire pressure monitoring sensor transmitters **16**. Each tire **14** of the vehicle **10** includes a corresponding transmitter **16**. The transmitters **16** rotate with the tires **14**. The rotation of the tire **14** can generate blind spots where a portion of the transmission **22** is blocked. The example receiver **18** includes a buffer **26** to store portions of the transmissions **22** to provide for reconstruction of data in response to portions of the transmission being blocked.

[0013] Referring to FIG. **2**, with continued reference to FIG. **1**, each transmission **22** includes several identical data frames. Each data frame includes a start of message sequence **44** and an end of message sequence **48**. Between the start of message **44** and the end of message sequences **44**, **48** is the data portion **46**. Each transmission includes a plurality of these identical data frames. In some instances only a portion of any data frame is received. A partially received data frame is not useful. The example method includes a process of reconstructing a complete data frame from portions of partially received data frames.

[0014] A first data frame **28** is transmitted from one of the transmitters **16** and is partially blocked as indicated at **36**. The receiver **18** receives only a partial portion of the transmitted data frame as indicated at **32** that includes the start message **44** sequence followed by some of data, but no end of message sequence **48**. Upon receipt of the partial data frame **32**, the receiver **18** saves that data in the buffer **26**. In the disclosed example, the receiver **18** saves all data that is received that falls within a defined transmission data rate range. The saved data is not decoded or otherwise processed; it is simply saved for latter processing if required.

[0015] A second data frame **30** is transmitted and is partially blocked as is schematically indicated at **38**. The blocked portion results in on a partial portion of the data frame as indicated at **34** being received. The second partial portion includes portions of the data and the end message sequence **48**. In response to the receipt of the partial data frame **34** including the end of message sequence **48** without a corresponding start of message sequence **44**, the receiver **18** begins decoding the buffered data frame **32**. The buffered data frame **32** includes the start message sequence **44** and a beginning portion of the data **46**. The currently received partial data frame includes the back end of the data the end of message sequence **48**. Together, the saved data frame **32** and the currently received partial data frame **34** comprise an entire message.

[0016] A reconstructed data frame **42** can be generated using the saved partial saved data frame **32** and the currently received partial data frame. Because the transmitted data frames **28** and **30** are identical, the data **46** can be reconstructed by checking for overlapping identical data. The overlapping identical data **46** is utilized to align the saved partial frame **32** with the received partial frame to create the combined and reconstructed data frame **42** that is processed and utilized by the receiver **18**.

[0017] In the event that a complete data frame is received after a portion of data is saved, that data is simply disregarded.

The buffer is then replaced with subsequent data frames until needed. In other words the data within the buffer is rotated to reflect the last received data frame or portions of that data frame. The receiver **18** is thereby prepared to recreate data frames if required and prompted by a received incomplete data frame including an end of message sequence **48** without a corresponding start of message sequence **44**.

[0018] As should be understood, the described example utilizes the receipt of an end of message sequence **48** without a corresponding start of message sequence **44** to prompt the combination of saved and currently received data. However, other prompts that are indicative of receipt of an incomplete data frame, such as receipt of the start message sequence **44** without a corresponding end of message sequence **48** could also be utilized. Further, other portions and indications of incomplete receipt of a data frame could be utilized such as for example data frame length.

[0019] Accordingly, the disclosed method and system provide for the recovery of partially received messages to decrease the possibility that data contained in any transmission is completely lost.

[0020] Although a preferred embodiment of this invention has been disclosed, a worker of ordinary skill in this art would recognize that certain modifications would come within the scope of this invention. For that reason, the following claims should be studied to determine the true scope and content of this invention.

What is claimed is:

1. A method of reconstructing incomplete data between a transmitter and a receiver comprising the steps of:

a) transmitting a signal from a transmitter that includes a plurality of data frames including a start message and an end message;

b) saving portions of the received signals; and

c) combining portions of the saved signals with subsequently received signals responsive to receiving incomplete portions of at least two of the plurality of data frames

2. The method as recited in claim **1**, wherein the saved signals are combined with portions of the saved signals responsive to receipt of an end message without a corresponding start message for any one of the plurality of data frames.

3. The method as recited in claim **2**, wherein the step of combining portions of the saved signals with subsequent ones includes decoding the saved portions of the received signals and combining the saved portions with received portions to create a complete data frame.

4. The method as recited in claim **2**, including the step of disregarding the saved portions of the received signals responsive to receipt of a start message.

5. The method as recited in claim **1**, including the step of saving received signals having a data rate common to a known data rate of a signal from the transmitter.

6. The method as recited in claim **1**, wherein the step of saving the received signals comprises buffering consecutive edge intervals of an incoming signal that are within a selected data rate tolerance band.

7. The method as recited in claim **1**, including combining portions of the saved signals with subsequently received signals and checking overlapping data to determine coherence of the created data frame.

8. A method of creating a complete data frame for a tire pressure monitoring system comprising the steps of:

a) sending a plurality of data frames including data indicative of conditions within a tire that includes a start portion indicating the beginning of a data frame and an end portion indicating an end of a data frame;

b) saving portions of incoming data frames in a coded condition; and

c) combining the saved portions of incoming data with subsequently received data frames responsive to receiving an end portion without receiving a corresponding start portion.

9. The method as recited in claim **8**, including the step of decoding the saved portions of incoming data frames responsive to receiving the end portion without the corresponding start portion.

10. The method as recited in claim **8**, including the step of matching the saved portions with the subsequently received portions to create a complete one of the plurality of data frames.

11. The method as recited in claim **10** including the step of matching data points of the saved portions of data with received portions to determine where to combine the saved portions of data with the received portions of data.

12. The method as recited in claim **8** wherein the saved portions of incoming data frames is disregarded responsive to receipt of a start portion of an incoming data frame.

13. The method as recited in claim **8**, including the step of saving portions of data that correspond with a desired data transfer rate of the transmitter.

14. The method as recited in claim **8**, wherein the transmitter sends a plurality of identical data frames for each pressure that is transmitted.

15. A tire pressure monitoring system comprising:

At least one transmitter generating a signal indicative of a pressure within a tire, wherein each of the signals include a plurality of identical data frames each including a start portion indicating the beginning of one of the plurality of data frames and an end portion indicating an end of a data frame; and

a receiver including a buffer for saving portions of incoming signals; the receiver combining saved portions of the incoming signals responsive to receiving the end portion without receiving a corresponding start portion.

16. The system as recited in claim **15**, wherein the receiver does not decode the saved portions until combined with a received message including an end portion without a start portion.

17. The system as recited in claim **15**, wherein the receiver saves portions of incoming signals comprising a data transmission rate with a desired range.

18. The system as recited in claim **15**, wherein the saved portions of the incoming signals are disregarded responsive to receiving a start signal.

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